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(58) Field of search  
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(71) Applicant  
Ford Motor Company  
Limited  
(Great Britain)  
Eagle Way  
Brentwood  
Essex

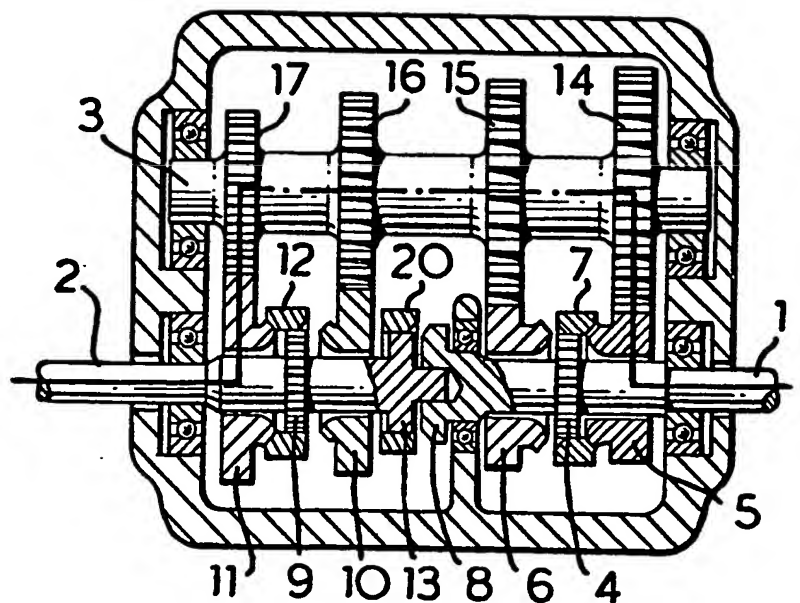
(72) Inventor  
Roy Anthony  
Reynoldson

(74) Agent and/or Address for  
Service  
Robert William  
Drakeford  
Ford Motor Company  
Limited  
15/488 Laindon  
Basildon  
Essex

## (54) Multi-speed layshaft gearbox

(57) A multi-speed gearbox comprises an input shaft (1) carrying a fixed gear (4) and one or more rotatable gears (5, 6), an output shaft (2) carrying a fixed gear (9) and one or more rotatable gears (10, 11) a layshaft (3) carrying a plurality of fixed gears (14-17) in engagement with the rotatable gears (5, 6, 10, 11) on the input and output shafts (1, 2), selector rings (7, 12) for selectively coupling the fixed gears (4, 9) on the input and output shafts, and means (8, 13, 20) for establishing a direct drive between the input and output shafts so that the layshaft is stationary when direct gear is selected, thereby reducing noise and wear and allowing a compact construction.

FIG.1



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FIG. 1

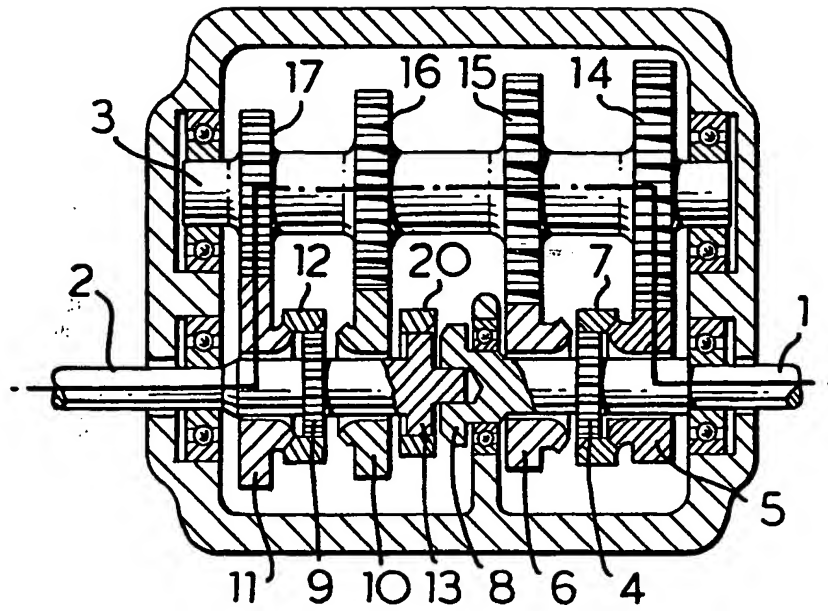


FIG. 2

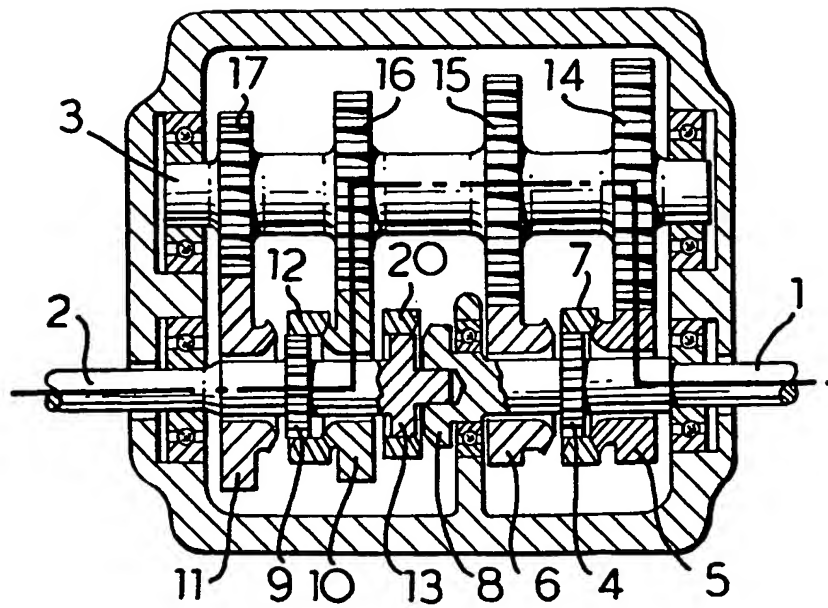


FIG. 3

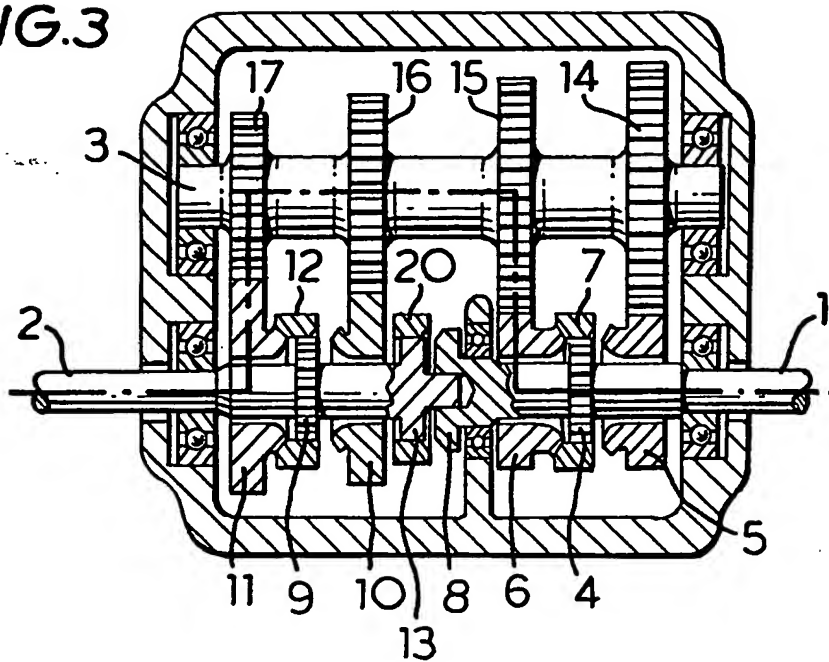


FIG. 4

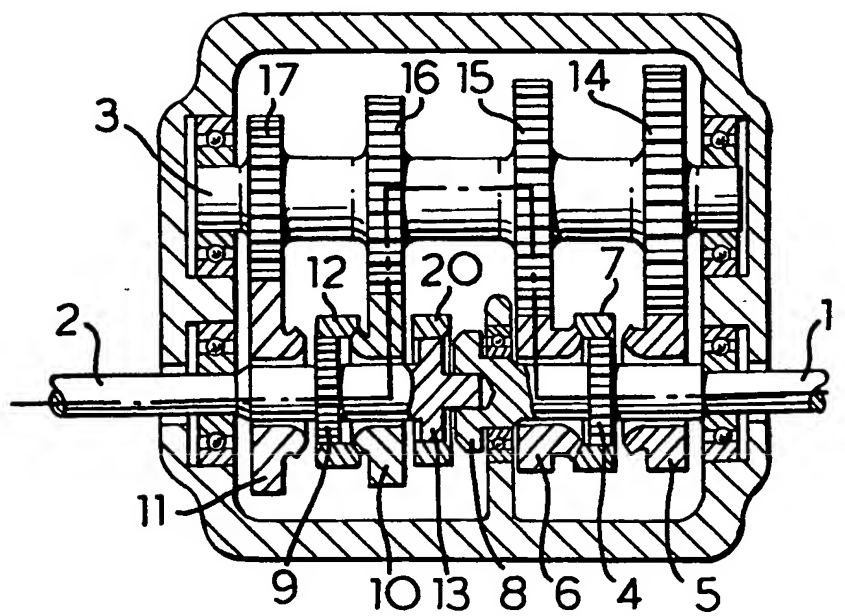
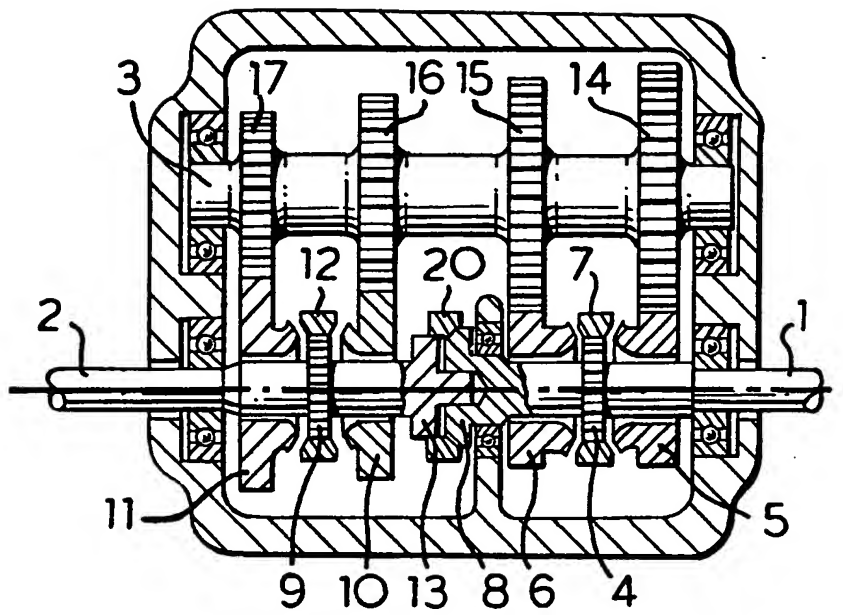


FIG. 5



## SPECIFICATION

## Multi-speed gearbox

- 5 This invention relates to multi-speed gear-boxes.

According to the present invention, there is provided a multi-speed gearbox comprising an input shaft carrying a fixed gear and at least

- 10 one rotatable gear, an output shaft carrying a fixed gear and at least one rotatable gear, a layshaft carrying a plurality of fixed gears in engagement with the rotatable gears on the input shaft and on the output shaft, selector
- 15 rings for selectively coupling the fixed gears on the input and output shafts to the rotatable gears on the input and output shafts, and means for establishing a direct drive between the input and output shafts.

- 20 By providing means for coupling the input shaft directly to the output shaft, a direct drive through the gearbox is established in which the layshaft is not driven. This permits a compact construction, a reduction in the
- 25 number of gears in the gearbox and a reduction in noise and wear when the gearbox is operating with a direct drive.

- Preferably the input and output shafts are coaxial, and the said means comprises a selector ring for selectively coupling fixed gears on the input and output shafts. The invention is especially suitable for a 5-speed gearbox, in which case the input and output shafts each carry two rotatable gears.

- 35 A preferred embodiment of the invention will now be described by way of example only with reference to the accompanying drawings which are each diagrams of a gearbox in accordance with the invention with the various gear ratios selected.

- 40 Referring to Fig. 1, a 5-speed gearbox comprises a housing in which an input shaft 1, and output shaft 2, and a layshaft 3 are all rotatably mounted. The input shaft 1 carries a
- 45 first fixed gear 4 and first and second rotatable gears 5, 6 mounted on opposite sides of the fixed gear and each provided with synchromesh cones. A first selector ring 7 is mounted on the input shaft 1 and may be
- 50 moved axially along the input shaft 1 by means of a selector fork (not shown) to effect a driving connection between the first fixed gear 4 and one or other of the adjacent rotatable gears 5, 6.

- 55 The inner end of the input shaft 1 carries a second fixed gear 8, which includes a synchromesh cone, and rotatably receives the inner end of the output shaft 2 which is coaxial with the input shaft 1. The output
- 60 shaft 2 carries a third fixed gear 9 and third and fourth rotatable gears 10, 11 mounted on opposite sides of the third fixed gear 9 and each provided with synchromesh cones. A second selector ring 12 is mounted on the
- 65 output shaft and may be moved axially along

the output shaft 2 by means of a selector fork (not shown) to effect a driving connection between the third fixed gear 9 and one or other of the adjacent rotatable gears 10, 11.

- 70 The inner end of the output shaft carries a fourth fixed gear 13 which lies next to the second fixed gear 8 on the input shaft 1 and may be connected thereto by third selector ring 20 which is slidable axially along the
- 75 output shaft 2 by means of a selector fork (not shown).

- The layshaft 3 is mounted parallel to the axes of the input and output shafts 1 and 2 and carries first, second, third and fourth fixed
- 80 gears 14-17 which mesh with the first, second, third and fourth rotatable gears 5, 6, 10, 11 on the input and output shafts respectively.

- The gearbox provides five forward gears in the following manner.

- The first gear ratio is selected by engaging the first selector ring 7 with the first fixed gear 4 and the first rotatable gear 5 on the input shaft 1; engaging the second selector
- 90 ring 12 with the third fixed gear 9 and the fourth rotatable gear 11 on the output shaft 2; and positioning the third selector ring 20 in engagement with the third fixed gear 13 on the output shaft 2 but out of engagement
- 95 with the second fixed gear 8 on the input shaft 1. The input and output shafts are thus coupled together via the first and fourth fixed gears 14, 17 on the layshaft 3, as illustrated by the arrows in Fig. 1.

- 100 The second gear ratio is selected by engaging the first selector ring 7 with the first fixed gear 4 and the first rotatable gear 5 on the input shaft 1; engaging the second selector ring 12 with the third fixed gear 9 and the
- 105 third rotatable gear 10 on the output shaft; and positioning the third selector ring 20 in engagement with the third fixed gear 13 on the output shaft 2 but out of engagement with the second fixed gear 8 on the input
- 110 shaft 1. The input and output shafts are thus coupled together via the first and third fixed gears 14, 16 on the layshaft 3, as illustrated in Fig. 2.

- The third gear ratio is selected by engaging
- 115 the first selector ring 7 with the first fixed gear 4 and the second rotatable gear 6 on the input shaft 1; engaging the second selector ring 12 with the third fixed gear 9 and the fourth rotatable gear 11 on the output shaft
- 120 2; and positioning the third selector ring 20 in engagement with the third fixed gear 13 on the output shaft 2, but out of engagement with the second fixed gear 8 on the input shaft 1. The input and output shafts are thus
- 125 coupled together via the second and fourth fixed gears 15, 17 on the layshaft 3, as illustrated in Fig. 3.

- The fourth gear ratio is selected by engaging the first selector ring 7 with the first fixed
- 130 gear 4 and the second rotatable gear 6 on the

input shaft 1; engaging the second selector ring 12 with the third fixed gear 9 and the third rotatable gear 10 in the output shaft 2; and positioning the third selector ring 20 in engagement with the third fixed gear 13 on the output shaft 2 but out of engagement with the second fixed gear 8 on the input shaft 1. The input and output shafts are thus coupled together via the second and third fixed gears 15, 16, on the layshaft 3, as illustrated in Fig. 4.

The fifth gear ratio, or direct drive, is selected by positioning the first and second selector rings 7, 12 in engagement with the first and third fixed gears 4, 9 on the input and output shafts 1, 2 respectively but out of engagement with either the first or the second rotatable gears 3, 6 or the third and fourth rotatable gears 10, 11 respectively; and engaging the third selector ring 20 in engagement with the third fixed gear 13 on the input shaft 2 and the second fixed gear 8 in the input shaft 1. The input and output shafts 1, 2 are thus coupled together directly, as illustrated in Fig. 5.

When the gearbox is in the fifth, gear ratio, or direct drive, the layshaft 3 is not connected to the input or output shafts 1, 2. Consequently, smaller frictional forces are generated in this gear ratio, and noise and wear are reduced. The gearbox is compact, and since it includes relatively few moving parts, it is cheap to produce.

### 35 CLAIMS

1. A multi-speed gearbox comprising an input shaft carrying a fixed gear and at least one rotatable gear, an output shaft carrying a fixed gear and at least one rotatable gear, a layshaft carrying a plurality of fixed gears in engagement with the rotatable gears on the input shaft and on the output shaft, selector rings for selectively coupling the fixed gears on the input and output shafts to the rotatable gears on the input and output shafts, and means for establishing a direct drive between the input and output shafts.

2. A gearbox according to claim 1 wherein the input and output shafts are coaxial, and the said means comprises a selector ring for selectively coupling fixed gears on the input and output shafts.

3. A gearbox according to claim 1 wherein the input and output shafts each carry two rotatable gears.

4. A multi-speed gearbox substantially as hereinbefore described, and as illustrated in the drawings.